



# **Sources and Thresholds for the United States Demonstration of an Attribute Measurement System with Information Barrier**

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# Sources and Thresholds

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- The authentication sources used in this demonstration are all regular assets of Los Alamos National Laboratory and are all unclassified.
- The goal of this presentation is to describe the nonweapon sources and how the thresholds that are used in the demonstration apply to them.



# • • • Sources Used in System Development •

- ***“ZPPR\* plates” arranged in an asymmetric configuration***
- **Larger ensemble of ZPPR plates**
- **Sample of recently processed Pu oxide**
- ***Large Pu oxide sample***
- **$^{252}\text{Cf}$  source (used for calibration only)**

\* ZPPR = Zero-Power Plutonium Reactor

**NOTE: Not all of these sources will be used in the demonstration; the demonstration sources are in *italics* above.**



# ZPPR Plates

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- Fabricated as fuel elements for the Zero-Power Plutonium Reactor many years ago
- ~25 grams each; 5 used in asymmetric source, more in “large” source
- Isotopics vary; pieces used contain ~12%  $^{240}\text{Pu}$
- Pu/Al alloy
  - Produce (alpha,n) neutrons but not an oxygen gamma line
  - An example of a source that emits (alpha,n) neutrons but passes the oxide test
- One group arranged in a highly asymmetric “dumbbell” geometry for the demonstration; the other group stacked together



# **“New” Plutonium Oxide**

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- **Produced prior to the shutdown of the last U.S. production reactor**
- **Separated from its americium during 1999**
- **Therefore fails the “age” criterion (requiring separation before 1/1/97)**
- **There is only time for 2 authentication measurements with the system in open mode, therefore this sample will not be used in the demonstration**



# Large Pu Oxide Sample

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- 1.5 kg PuO<sub>2</sub>
- ~6% <sup>240</sup>Pu
- Geometry uncertain, since oxide is prone to shifting in its container, but normally appears axially symmetrical



# Californium Source

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- Emits ~10,000 n/sec
- Contains no plutonium
- Used in the calibration measurements

**NOTE: Emission of neutrons is anisotropic for certain Cf sources (but not this one).**



# Thresholds

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- Chosen for this demonstration only
- All are unclassified
- Thresholds are consistent with previous discussion between the U.S. and Russian Federation



# Thresholds

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- Presence of Pu: characteristic peak(s) significant at the 5- $\sigma$  level
- Isotopics:  $^{240}\text{Pu}/^{239}\text{Pu}$  ratio  $<0.1$

Note: the ZPPR plates might be expected to pass this test  
~2% of the time owing to counting statistics.

- Mass: 500 grams
- Age: separated from Am before 1/1/97
- Symmetry: less than  $\pm 15\%$  excursions in measurements in 8 detector banks arranged around the container's axis of symmetry



# Oxide Thresholds

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- The oxide measurement differs from the others in its use of two thresholds:
  - Threshold 1:  $\alpha > 0.5$ , i.e., excess neutrons from multiplicity counter.
  - Threshold 2: 871-keV peak from first excited state of  $^{17}\text{O}$  is present at the 3- $\sigma$  level.
- **Both thresholds must be met if oxide is to be recognized as present (red light is illuminated):**
  - if either threshold is not met, oxide is deemed not present and the “absence of oxide” light (green) is illuminated.



# Expected Outcomes of Applying Thresholds

Sample	Isotopics?	Mass?	No oxide?	Pu present?	Symmetry?	Age?
ZPPR plates in compact configuration	●*	●	●	●	●	●
ZPPR plates in "dumbbell" configuration	●*	●	●	●	●	●
Large oxide sample	●	●	●	●	●	●
New oxide	●	●	●	●	●	●
Component	●	●	●	●	●	●

\* (Rare "pass" results possible because of counting statistics.)

